Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/IL05/000250

International filing date: 03 March 2005 (03.03.2005)

Document type: Certified copy of priority document

Document details: Country/Office: IL
Number: 160738
Filing date: 04 March 2004 (04.03.2004)

Date of receipt at the International Bureau: 13 April 2005 (13.04.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

PCT/IL05/000250

מדינת ישראל
STATE OF ISRAEL

משרד המשפטים
לשכת הפטנטים

Ministry of Justice
Patent Office

זאת לתעודה כי

This is to certify that

רצופים בזה העתקים

annexed hereto is a true

נכונים של המסמכים

copy of the documents as

שהופקדו לכתחילה

originally deposited with

עם הבקשה לפטנט

the patent application

לפי הפרטים הרשומים

particulars of which are

בעמוד הראשון של

specified on the first page

הנספח.

of the annex.

היום 13-03-2005 This .....

רשם הפטנטים

Commissioner of Patents

נתאשר
Certified

(K) A61M

חוק הפטנטים, תשכ"ז - 1967
PATENT LAW, 5727-1967

ב ק ש ה ל פ ט נ ט
Application for Patent

לשימוש הלשכה
For Office Use

מספר : Number	160738
תאריך : Date	04 -03- 2004
הוקדם/ נדחה Ante/Post-dated	

אני, (שם המבקש, מענו ולגבי גוף מאוגד - מקום התאגדותו)
I (Name and address of applicant, and in case of body corporate-place of incorporation)

1) Shai Amisar
18/B Nahalat Itzhak Street
Suite 241, Migdaley Tel-Aviv,
Tel-Aviv 67448 An Israeli Citizen

1) שי עמישר
רח' נחלת יצחק 18/ב', דירה 241
מגדלי תל אביב
תל-אביב 67448 אזרח ישראלי

2) Ronen Radomski
9 Oren Street
Haifa 34731 An Israeli Citizen

2)רונן רדומסקי
רח' אורן 9
חיפה 34731 אזרח ישראלי

3) Baruch Segal
26/22 Mashabim Street
Hod-Hasharon 45201 An Israeli Citizen

3) ברוך סגל
רח' משאבים 26/22
הוד השרון 45201 אזרח ישראלי

1) +2) בעל אמצאה מכוח היותנו הממציאים of an invention the title of which our being the Inventors

שמה הוא
1) +2) Owner, by virtue of

3) בעל אמצאה מכוח הדין of an invention the title of which is the Law

שמה הוא
3) Owner, by virtue of

(בעברית)
(Hebrew) התקן לניטור זרימת נוזלים

(באנגלית)
(English) LIQUID FLOW MONITORING APPARATUS

מבקש בזאת כי ינתן לי עליה פטנט
hereby apply for a patent to be granted to me in respect thereof.

בקשת חלוקה Application of Division	בקשת פטנט מוסף Application for Patent Addition	דרישה דין קדימה Priority Claim		
מבקשת פטנט from Application	לבקשה / לפטנט to Patent / Appl	מספר/סימן Number / Mark	תאריך Date	מדינת האגוד Convention Country
מס' No._____	מס' No._____			
מיום dated_____	מיום dated_____			
יפוי כח: כללי / מיוחד / - רצוף בזה / ערד יוגש P.O.A. : general / individual-attached / to be filed later				
הוגש בענין filed in case_____				
המען למסירת מסמכים בישראל: ירמיהו מ. בן-דוד ושות' בע"מ ת.ד. 45087 ירושלים 91450 Address for Service in Israel: Jeremy M. Ben-David & Co. Ltd. POBox 45087 Jerusalem 91450				
חתימת המבקש Signature of Applicant		היום 4 בחודש מרץ שנת 2004 This 4nd day of March of the year 2004		

Our ref.: CYC-P 472/7.1 מספרנו:

לשימוש הלשכה
For Office Use

טופס זה, כשהוא מוטבע בחותם לשכת הפטנטים ומושלם במספר ובתאריך ההגשה, היינו אישור להגשת הבקשה שפרטיה רשומים לעיל.
This form, impressed with the Seal of the Patent Office and indicating the number and date of filing, certifies the filing of the application, the particulars of which are set out above.

התקן לניטור זרימת נוזלים

LIQUID FLOW MONITORING APPARATUS

1) שי עמישר
2) רונן רדומסקי
3) ברוך סגל

1) Shai Amisar
2) Ronen Radomski
3) Baruch Segal

CYC-P 472/7.1

LIQUID FLOW MONITORING APPARATUS

FIELD OF THE INVENTION

The present invention generally relates to liquid flow monitoring and, more specifically to liquid flow control and measurement apparatus.

BACKGROUND OF THE INVENTION

It is known in the art to provide intravenous delivery of liquids and medicaments to a subject. Intravenous therapy is generally carried out by feeding medicament together with or in the absence of saline solution from a bag or other supply source. The rate of delivery is generally controlled using a valve associated with a flow-monitoring device. The flow rate is commonly monitored in accordance with an observed droplet rate passing through a droplet-monitoring device.

Known droplet-monitoring devices have several drawbacks, including the following: the liquid flow rate is not readily observable at a glance; counting the droplet rate is both time consuming and not easily discernible; the device is required to be in a substantially stationary, vertical position, having the supply bags of medicament and saline suspended thereabove; and controlling an intravenous flow to a subject under emergency conditions outside of a hospital environment may prove problematic if not impossible using a droplet counter device.

An understanding of the state of the art may be obtained with reference to the following United States patents: US 4,136,692 to Goldowsky on January 30, 1979; US 5,005,604 to Aslanian on April 9, 1991; US 5,267,957 to Kriesel, et al. US 5,402,686 to Wittman on April 4 1995; US 5,499,968 to Milijasevic, et al.; US 5,840,071 and US 6,176,845 to Kriesel, et al. on November 24, 1998 and January 23, 2001, respectively; and US 6,679,865 to Shekalim on January 20, 2004.

SUMMARY OF THE INVENTION

The present invention aims to provide an accurate and consistent liquid flow monitoring apparatus for intravenous therapy under circumstances and in environments that include hospitals, places of alternate healthcare, emergency events in the field and in circumstances where stability and consistency are generally problematic or nonexistent. Furthermore, the present invention seeks to provide monitoring of intravenous therapy with minimal participation by healthcare professionals, providing a readily observed indication of the flow status.

According to a preferred embodiment of the present invention, there is provided apparatus for monitoring liquid flow including a generally elongate housing having first and second ends having formed therein a liquid inlet and outlet, respectively, for permitting a liquid flow through the housing. The housing has a cross-sectional profile, which varies along the length of the housing so as to impart predetermined flow characteristics to a liquid flowing therethrough. The apparatus further includes a flow rate indicator float disposed within the housing operative to be displaced therealong in accordance with a liquid flow rate therethrough and flow rate indicator means associated with the float member, for providing a position related indication of the rate of liquid flow through the housing.

According to another preferred embodiment of the present invention, there is provided an intravenous therapy apparatus including one or more supply members of intravenous liquid, a supply tube apparatus arranged in liquid flow communication with each supply member including a flow regulating valve and an intravenous insertion member connected in flow communication with the supply tube apparatus. There is also included an apparatus for monitoring liquid flow. The fluid flow monitoring apparatus includes a generally elongate housing having first and second ends having formed therein a liquid inlet and outlet, respectively, for permitting a liquid flow through the housing, wherein the housing has a cross-sectional profile which varies along the length of the housing so as to impart predetermined flow characteristics to a liquid flowing therethrough. Additionally, there is included a flow rate indicator float disposed within the housing operative to be displaced therealong in accordance with a liquid flow rate therethrough and flow

rate indicator means associated with the float member, for providing a position related indication of the rate of liquid flow through the housing.

According to a first embodiment of the present invention, the apparatus for monitoring liquid flow includes a portion of the generally elongate housing formed having a conical-shaped internal surface.

According to a second embodiment of the present invention, the generally elongate housing is formed having a first housing portion having a conical-shaped internal surface and a second housing portion having a cylindrical internal surface thereby to provide for an increased liquid flow therethrough.

According to a third embodiment of the present invention, the generally elongate housing includes a side-wall having a generally cylindrical configuration and a longitudinal axis and having one or more diametric slots formed within and along the longitudinal axis, wherein the slot has a predetermined lateral width and has a diametric width which varies along the longitudinal axis, thereby to impart to the housing a varying cross-sectional area accordingly.

According to a fourth embodiment of the present invention, the housing includes a plurality of internally stepped housing portions thereby to impart to the housing a varying cross-sectional area accordingly.

According to a fifth embodiment of the present invention, one or both of the first and second housing ends have internal recesses formed therein concentric with the inlet and outlet so as to provide a valve seat for operationally engaging the flow rate indicator float thereby to close off liquid flow through the generally elongate housing.

According to a sixth embodiment of the present invention, the flow rate indicator float is generally cylindrical having integral first and a second end walls.

According to a variation of the sixth embodiment of the present invention, one or both of the first and the second end wall are formed having a conical protrusion formed concentrically therewith for operationally engaging the internal recesses formed in the first and second housing ends thereby to close off liquid flow through the generally elongate housing.

According to a seventh embodiment of the present invention, the flow rate indicator float is formed having a plurality of projections protruding generally radially therefrom thereby to reduce contact of the float with the generally elongate housing.

According to an eighth embodiment of the present invention, the flow rate indicator float is spherical.

According to a ninth embodiment of the present invention, the generally elongate housing includes a housing bypass channel in operative association with a valve member for providing a liquid flow to bypass the displacement float member.

According to a tenth embodiment of the present invention, the flow rate indicator float is formed having a hollow therein so as to entrap gas therein, thereby to increase the buoyancy thereof.

According to an eleventh embodiment of the present invention, the flow rate indicator float includes apparatus for providing a remote signal indicative of the displacement of the flow rate indicator float and thereby of the liquid flow through the elongate housing.

Furthermore, there is provided a method for monitoring a liquid flow rate through an intravenous therapy apparatus, the method steps include:

a) purging air from a liquid flow monitoring apparatus by causing liquid to flow from a liquid supply member into a liquid inlet of the intravenous therapy apparatus and therethrough;

b) preselecting a rate of flow of liquid through the intravenous therapy apparatus;

c) providing a visual indication of the rate of liquid flow through the liquid flow monitoring apparatus as indicated on a flow rate indicator means, by linear displacement of a flow rate indicator float;

d) selectably adjusting the rate of liquid flow through the intravenous therapy apparatus; and

e) visually inspecting the position of the flow rate indicator float against the flow rate indicator means, thereby ascertaining the liquid flow through the intravenous therapy apparatus.

The method steps include an additional step following the step a), the additional step of second purging air from the at least one flow monitoring apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully understood and its features and advantages will become apparent to those skilled in the art by reference to the ensuing description, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a schematic view of a liquid flow rate monitoring apparatus with no liquid flowing therethrough;

Figure 2 is a schematic view of a liquid flow rate monitoring apparatus with liquid flowing at a preselected rate therethrough;

Figure 3 is a schematic view of a liquid flow rate monitoring apparatus with a high rate of flow therethrough;

Figure 4 is a schematic view of a liquid flow rate monitoring apparatus with an excessive liquid flow therethrough;

Figure 5 is a schematic view of a liquid flow rate monitoring apparatus illustrating a cessation of liquid flow;

Figure 6 is a schematic view of a liquid flow rate monitoring apparatus including a float with an occluded bubble of gas;

Figure 7 is a schematic view of a liquid flow rate monitoring apparatus including a float with an occluded bubble of gas sealed therein;

Figure 8 is a schematic view of a liquid flow rate monitoring apparatus including a float with an added float element;

Figure 9 is a schematic view of a liquid flow rate monitoring apparatus having a diametric housing slot;

Figure 10 is a cross-sectional view of an upper housing portion of apparatus shown in Figure 9;

Figure 11 is a cross-sectional view of a lower housing portion of apparatus shown in Figure 9;

Figure 12 is a schematic view of a liquid flow rate monitoring apparatus having a housing formed of a plurality of stepped cylindrical housing portions;

Figure 13 is a schematic view of a liquid flow rate monitoring apparatus having a liquid by-pass;

Figure 14 is a schematic view of a liquid flow rate monitoring apparatus having an open liquid bye-pass valve;

Figure 15 and 16 are schematic views of liquid flow rate monitoring apparatus having floats with radial protrusions;

Figure 17 is a schematic view of a liquid flow rate monitoring apparatus having a spherical float; and

Figure 18 is a schematic view of an intravenous apparatus including a liquid flow rate monitoring apparatus.

DETAILED DESCRIPTION OF THE INVENTION

Whilst the details that follow hereinbelow generally relate to monitoring the flow rate of liquids in intravenous therapy, it will be apparent to persons skilled in the art, that embodiments of the present invention are applicable to many fields and applications. Such applications include those requiring sensitive and accurate liquid flow monitoring, especially at low flow rates. Applications include laboratory work, chemical processing and manufacturing, and biochemical manufacturing, to mention a few. Liquids to be monitored include liquids and corrosive or toxic liquids.

There is a need in the art for apparatus, which accurately monitors intravenous therapy. This is particularly applicable with patients in an emergency situation, including outside of a hospital environment. Further, it is advantageous to monitor intravenous therapy with a minimal of professional participation or supervision. The presently generally utilized droplet monitoring flow device cannot effectively function without the presence of air in the tubing, which can prove problematic in treatment under non-ideal circumstances.

According to embodiments of the present invention, as shown and described below in conjunction with Figures 1-18, the flow monitoring apparatus of the present invention is compact, and inexpensive. Furthermore, visual indication of the flow rate is readily discernible and operates without the necessity of air in the system. In addition, the flow monitoring apparatus can be used with minimal professional assistance, which is particularly beneficial in an alternate health care environment, such as the home or under virtually any emergency situation.

With reference to Figures 1 to 3 there is seen, according to a preferred embodiment of the present invention, a liquid flow rate monitoring apparatus generally referenced 10. Monitoring apparatus 10 includes a housing generally referenced 12 having an at least partially optically transparent generally cylindrical side-wall referenced 14 integrally formed with and disposed between first, upper and second, lower housing ends referenced 16 and 18, respectively. A liquid inlet referenced 20, and a liquid outlet referenced 22, are formed respectively in first and

second housing ends 16 and 18 having formed within ends 16 and 18, conical-shaped recesses referenced 24 and 26.

Side-wall 14 is formed having in an upper portion generally referenced 28 thereof an internal conical shaped portion referenced 30 and having in a lower internal portion generally referenced 32 an internal cylindrical shaped portion referenced 34. Internal diameter of cylindrical shaped portion 34 is formed larger than the maximum diameter of conical shaped portion 30.

Disposed within housing 12 is a float referenced 40, formed having a generally cylindrical shape and with transverse generally planar upper and lower end faces referenced 42 and 44 respectively. Formed on upper and lower end faces 42 and 44 are generally conical protrusions 46 and 48 respectively which are so shaped so as to provide a liquid seal when coming into operative engagement with conical shaped recesses 24 and 26 respectively. Float 30 is formed so as to have buoyancy relative to liquids to be applied to monitoring apparatus 10. The buoyancy of float 30 relative to the liquid to be monitored is preselected to provide a predetermined flow range for the liquid as disclosed hereinbelow.

When liquid enters through inlet 20 of flow monitoring apparatus 10 from a regulated liquid supply (not shown), a liquid flow force is applied to cause float 40 to be displaced downward within housing 12 against the buoyancy of float 12. As float 40 is caused to be displaced downwards within housing 12, annular gap referenced 50 between float 40 and conical shaped portion 30 of side-wall 14 is caused to progressively widen thereby providing for a progressively greater flow of liquid therethrough. When the downward pressure exerted on float 40 by the flowing liquid is counterbalanced by the upward thrust caused by the buoyancy of float 40, float 30 arrives at an equilibrium, stationary position within housing 12 as seen in Figure 2. Float 40 functions also as a flow rate indicator, substantially in proportion to the rate of liquid flow through monitoring apparatus 10, the liquid flow eventually exiting through outlet 22. The actual flow rate may be observed with reference to the position of float 40, relative to a calibrated scale (not shown), disposed axially along side-wall 14 in visual proximity thereto.

In accordance with an embodiment of the present invention, there is disposed within float 40 apparatus (not shown) for providing a remote signal indicative of the displacement of float 40.

In accordance with another embodiment of the present invention, referring now to Figure 4, in response to an increase in flow, float 30 is caused to be displaced downwards within housing 12 into internal cylindrical portion 34 as seen in Figure 3. With a further, excessive, increase in flow, float 30 is displaced downward so that lower face 44 and lower conical protrusion 48 are caused to engage lower end wall 18 and conical recess 26 respectively, thereby causing a cessation of the excessive flow.

Furthermore, referring to Figure 5, in response to a cessation of the intravenous liquid flow, float 30 rises within housing 12 so that upper face 42 and upper conical protrusion 46 are caused to engage upper end wall 16 and conical recess 24 therein, respectively, effectively closing off any reverse flow, such as any blood out-flow from an intravenously placed cannula (not shown).

In accordance with embodiments of the present invention, the range over which the rate of flow is to be monitored is determined by preselecting a float having a buoyancy predetermined for the range of flow required..

Monitoring apparatus 10 can be used for continuous infusion of antibiotics, hormones, steroids, blood-clotting agents, analgesics, saline solution and other medicinal agents. Similarly, monitoring apparatus 10 can be used for intravenous chemotherapy. Accurate delivery of liquids, at flow rates as low as 40 ml/hour or less, at precise discernable rates and over extended periods of time, with minimal professional participation is feasible in accordance with embodiments of the present invention.

In accordance with embodiments of the present invention, the range over which the rate of flow is to be monitored is determined by preselecting alternative float configurations as are disclosed herein below.

Referring now to Figures 6, in accordance with a further embodiment of the present invention, there is seen a liquid flow rate monitoring apparatus generally referenced 100 having a housing referenced 102 substantially similar to that disclosed hereinabove in relation to Figures 1 to 4. An alternative float generally

referenced 104 is operative in housing 102. Float 104 has a hollow referenced 106, formed in an under-side generally referenced 108, thereby to provide increased buoyancy to float 104 such that a higher flow of liquid may be utilized through housing 100.

Referring now to Figures 7, in accordance with one other embodiment of the present invention, there is seen a liquid flow rate monitoring apparatus generally referenced 120 having a housing referenced 122 substantially similar to that disclosed hereinabove in relation to Figures 1 to 4. A hollow float generally referenced 124 is operative in housing 122. Float 124 has a hollow referenced 126, formed in an under-side generally referenced 128 thereof. A closure element referenced 130 is fixably transversely disposed into underside 128 so as to seal hollow 126. The entrapped gas in hollow 126 provides increased buoyancy to float 124 such that a higher flow of liquid may be utilized through housing 120.

Referring now to Figures 8, in accordance with an added embodiment of the present invention, there is seen a liquid flow rate monitoring apparatus generally referenced 140 having a housing referenced 142 substantially similar to that disclosed hereinabove in relation to Figures 1 to 4. A float generally referenced 144 is operative in housing 142. Float 144 has a supplementary float portion referenced 146, fixably disposed in an under-side portion generally referenced 148, such that supplementary float portion 146 provides increased buoyancy of float 144 such that a higher flow of liquid may be utilized through housing 140.

Referring now to Figures 9, 10 and 11, in accordance with another embodiment of the present invention, there are seen schematic views of a liquid flow rate monitoring apparatus generally referenced 160, having a variable depth diametric housing slot referenced 162. As disclosed hereinabove in relation to Figures 1-3, housing 12 is formed with a linearly variable cross-sectional area, specifically a conical shaped internal side-wall 14. In Figure 9 housing 164 is formed with a cylindrical side-wall 166 having one or more internal diametric slots 162, axially disposed in side-wall referenced 166 having a preselected width. As seen in Figure 10, which is a cross-sectional view taken at 1-1 in Figure 9, the diametric depth of slot 162, measured close to the inlet end portion referenced generally 170 is substantially small and increases along the length of side-wall 164

to reach a maximum preselected depth adjacent to the outlet end portion referenced 172 as illustrated in Figure 11 which is a cross-sectional view taken at 2-2 in Figure 9. This variable depth of slot 162 provides a variable cross-sectional flow area to provide a displacement of float referenced 174 in accordance with the rate of flow of liquid through housing 164. It will be appreciated by persons skilled in the art that additional slots similar to slot 162 formed in the interior of housing 164 will provide added variation to the cross-sectional flow area of housing 164.

Referring now to Figure 12, in accordance with one other embodiment of the present invention, there is seen a schematic view of a liquid flow rate monitoring apparatus generally referenced 175 having a side-wall referenced 177 formed as a plurality of stepped cylindrical housing portions referenced 179 having varied internal diameters arranged sequentially. The arrangement of the plurality of housing portions 179, provides side-wall 177 effectively with a conical shape which provides a variable cross-sectional flow area so as to provide a displacement of float referenced 181 in accordance with the rate of flow of liquid through housing referenced 183.

Referring now to Figures 13 and 14, in accordance with a further embodiment of the present invention, there are seen schematic views of a liquid flow rate monitoring apparatus generally referenced 180 having a liquid by-pass referenced generally 182 formed in side-wall referenced 184 of housing referenced 186. Liquid by-pass 182 includes an axial channel referenced 188 and a stop-cock referenced 190 which is maintained in a closed position as seen in Figure 13 during regular use. After the flow of liquid is terminated, so as to provide a quick-acting zero flow indication, stop-cock 190 is opened as seen in Figure 14 so as to cause float referenced 192 to rise rapidly to the inlet end generally referenced 194 of housing 186.

In accordance with an additional embodiment of the present invention, referring now to Figures 15 and 16 there is seen examples of schematic views of liquid flow rate monitoring apparatus generally referenced 200 and 220 respectively. In Figure 15, so as to reduce the drag effect or adherence due to liquid surface tension of float referenced 202 on side-wall 204, there are formed a plurality of projections referenced 206 protruding generally radially from float 202.

Similarly, in Figure 16, so as to reduce the drag effect of float referenced 222 on side-wall 224, there are formed a plurality of projections referenced 226 protruding generally radially from float 222. It will be appreciated by persons skilled in the art, that Figures 15 and 16 represent examples of projections and that the type and number of such protrusions is not limited by the examples disclosed hereinabove.

Referring now to Figure 17 in accordance with an added embodiment of the present invention, there is seen schematic view of a liquid flow rate monitoring apparatus generally referenced 230 having a spherical float referenced 232, which has advantages of reduced drag against side-wall 234, greater stability and also serves as a closure against reverse flow at inlet recess 236 when there is no liquid flow and serves as a closure against outlet recess 238 when the liquid flow rate becomes excessive.

In accordance with a further embodiment of the present invention and referring now to Figure 18, there is seen a schematic view of an intravenous apparatus referenced generally 240. Apparatus 240 includes flexible tubing referenced 246 interconnecting one or more bags referenced 242 of medicament, saline solution or nutrients, supported in a position generally higher than the patient to facilitate flow by gravity from the bag to the patient. Operatively connected to each bag 242 requiring a controlled flow rate therefrom is a liquid flow monitoring apparatus referenced 244 in operative association with a valve referenced 248, and connected to an intravenous needle/cannula unit referenced 250 for introducing medicament, saline solution or nutrients into a vein (not shown) of a patient.

In accordance with an embodiment of the present invention, there is a method for monitoring a liquid flow rate through an intravenous therapy apparatus, the method steps including:

a) purging air from a liquid flow monitoring apparatus by causing liquid to flow from a liquid supply member into a liquid inlet of the intravenous therapy apparatus and therethrough;

b) preselecting a rate of flow of liquid through the intravenous therapy apparatus;

c) providing a visual indication of the rate of liquid flow through the liquid flow monitoring apparatus as indicated on a flow rate indicator means, by linear displacement of a flow rate indicator float;

d) selectably adjusting the rate of liquid flow through the intravenous therapy apparatus; and

e) visually inspecting the position of the flow rate indicator float against the flow rate indicator means, thereby ascertaining the liquid flow through the intravenous therapy apparatus.

The method steps, according to an embodiment of the present invention, include an additional step following step a), of second purging of air from the flow monitoring apparatus.

It will be appreciated by persons skilled in the art that the present invention is not limited by the drawings and description hereinabove presented. Rather, the invention is defined solely by the claims that follow.

CLAIMS

1. Apparatus for monitoring liquid flow including:

   a) a generally elongate housing having first and second ends having formed therein a liquid inlet and outlet, respectively, for permitting a liquid flow through said housing, wherein said housing has a cross-sectional profile which varies along the length of said housing so as to impart predetermined flow characteristics to a liquid flowing therethrough; and

   b) a flow rate indicator float disposed within said housing operative to be displaced therealong in accordance with a liquid flow rate therethrough; and

   c) flow rate indicator means associated with said float member, for providing a position related indication of the rate of liquid flow through said housing.

2. Intravenous therapy apparatus including:

   a) at least one supply member of intravenous liquid;

   b) a supply tube apparatus arranged in liquid flow communication with said at least one supply member including at least one flow regulating valve;

   c) intravenous insertion member connected in flow communication with said supply tube apparatus; and

   d) at least one apparatus for monitoring liquid flow including:

      i) a generally elongate housing having first and second ends having formed therein a liquid inlet and outlet, respectively, for permitting a liquid flow through said housing, wherein said housing has a cross-sectional profile which varies along the length of said housing so as to impart predetermined flow characteristics to a liquid flowing therethrough;

ii) a flow rate indicator float disposed within said housing operative to be displaced therealong in accordance with a liquid flow rate therethrough; and

iii) flow rate indicator means associated with said float member, for providing a position related indication of the rate of liquid flow through said housing.

3. Apparatus for monitoring liquid flow according to claim 1, wherein at least one a portion of said generally elongate housing is formed having a conical-shaped internal surface.

4. Apparatus for monitoring liquid flow according to claim 1, wherein said generally elongate housing is formed having a first housing portion having a conical-shaped internal surface and a second housing portion having a cylindrical internal surface thereby to provide for an increased liquid flow therethrough.

5. Apparatus for monitoring liquid flow according to claim 1, wherein said generally elongate housing includes a side-wall having a generally cylindrical configuration and a longitudinal axis and having at least one diametric slot formed within and along said longitudinal axis, wherein said slot has a predetermined lateral width and has a diametric width which varies along said longitudinal axis, thereby to impart to said housing a varying cross-sectional area accordingly.

6. Apparatus for monitoring liquid flow according to claim 1, wherein said housing includes a plurality of internally stepped housing portions thereby to impart to said housing a varying cross-sectional area accordingly.

7. Apparatus for monitoring liquid flow according to claim 1, wherein at least one of said first and second housing ends have internal recesses formed therein concentric with said inlet and outlet so as to provide a valve seat for

operationally engaging said flow rate indicator float thereby to close off liquid flow through said generally elongate housing.

8. Apparatus for monitoring liquid flow according to claim 1, wherein said flow rate indicator float is generally cylindrical having integral first and a second end walls.

9. Apparatus for monitoring liquid flow according to claim 8, wherein said at least one of said first and said second end wall are formed having a conical protrusion formed concentrically therewith for operationally engaging said internal recesses formed in said first and second housing ends thereby to close off liquid flow through said generally elongate housing.

10. Apparatus for monitoring liquid flow according to claim 1, wherein said flow rate indicator float is formed having a plurality of projections protruding generally radially therefrom thereby to reduce contact of said float to said generally elongate housing.

11. Apparatus for monitoring liquid flow according to claim 1, wherein said flow rate indicator float is spherical.

12. Apparatus for monitoring liquid flow according to claim 1, wherein said generally elongate housing includes a housing bypass channel in operative association with a valve member for providing a liquid flow to bypass said displacement float member.

13. Apparatus for monitoring liquid flow according to claim 1, wherein said flow rate indicator float is formed having a hollow therein so as to entrap gas therein, thereby to increase the buoyancy thereof.

14. Apparatus for monitoring liquid flow according to claim 1, wherein said flow rate indicator float includes apparatus for providing a remote signal indicative of the displacement of said flow rate indicator float and thereby of the liquid flow through said elongate housing.

15. A method for monitoring a liquid flow rate through an intravenous therapy apparatus, the method steps including:

a) purging air from a liquid flow monitoring apparatus by causing liquid to flow from a liquid supply member into a liquid inlet of the intravenous therapy apparatus and therethrough;

b) preselecting a rate of flow of liquid through the intravenous therapy apparatus;

c) providing a visual indication of the rate of liquid flow through the liquid flow monitoring apparatus as indicated on a flow rate indicator means, by linear displacement of a flow rate indicator float;

d) selectably adjusting the rate of liquid flow through the intravenous therapy apparatus; and

e) visually inspecting the position of the flow rate indicator float against the flow rate indicator means, thereby ascertaining the liquid flow through the intravenous therapy apparatus.

16. The method according to claim 15 wherein said method steps include an additional step following said step a), said additional step includes second purging air from the at least one flow monitoring apparatus.

17. The invention according to any of claims 1-16, and substantially as shown and described hereinabove in conjunction with any of Figs. 1-18.

18. The invention according to any of claims 1-16, and substantially as shown in any of Figs. 1-18.

For the Applicants,

Jeremy M. Ben-David & Co. Ltd.
CYC-P 472/7.1

Fig 1

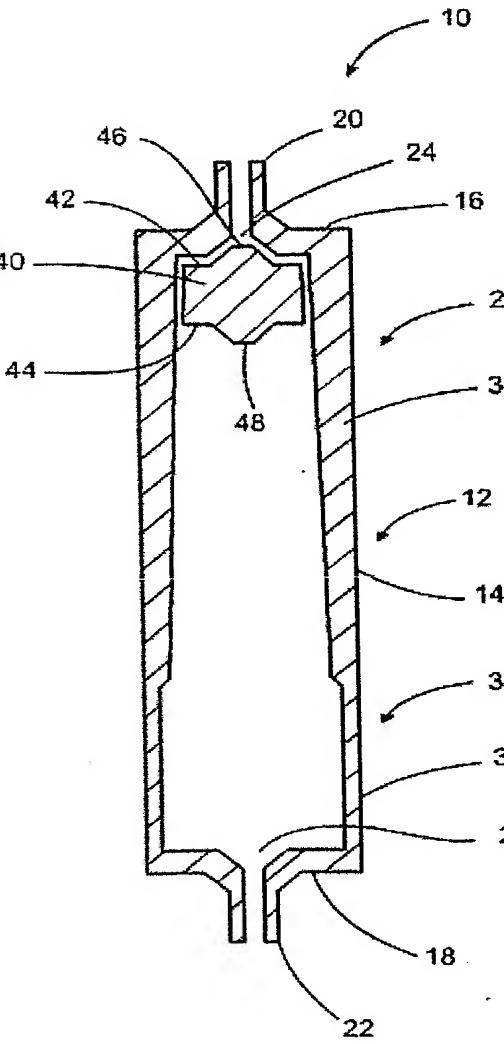


Fig 2

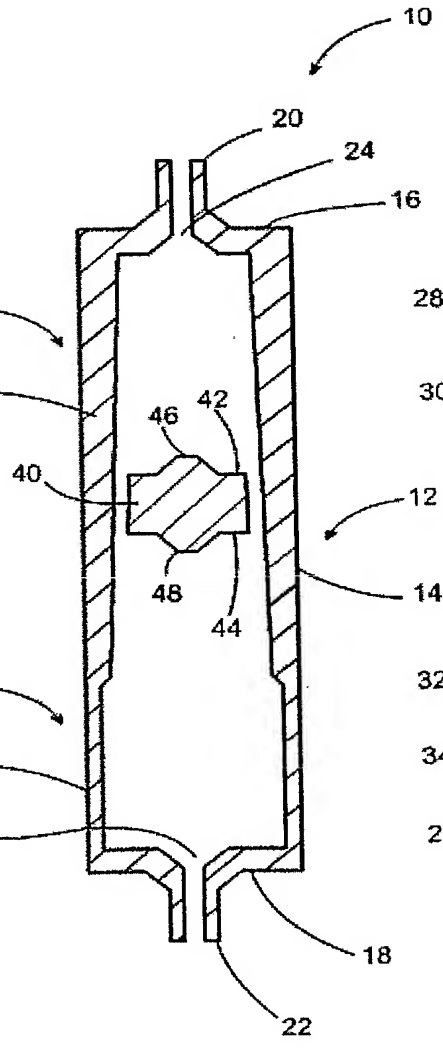


Fig 3

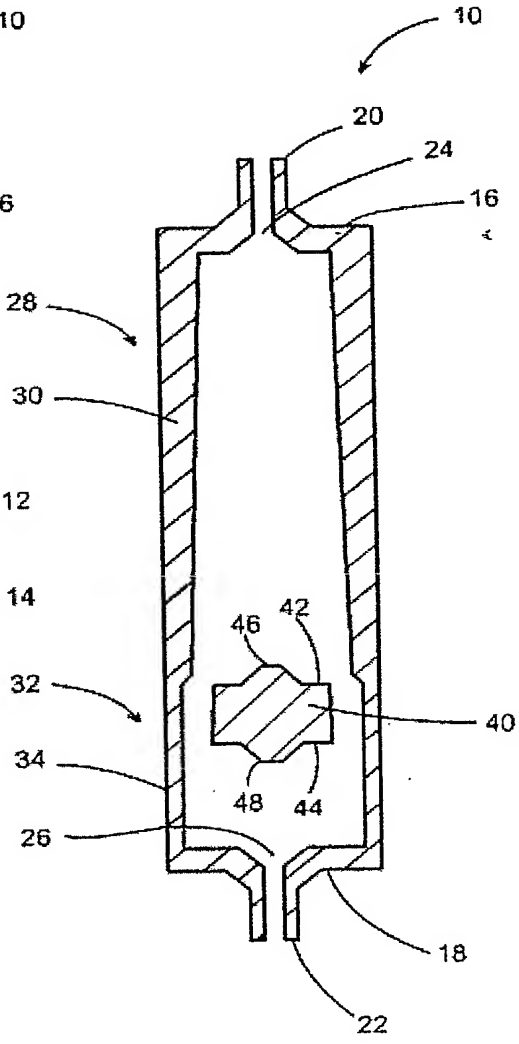


Fig 5

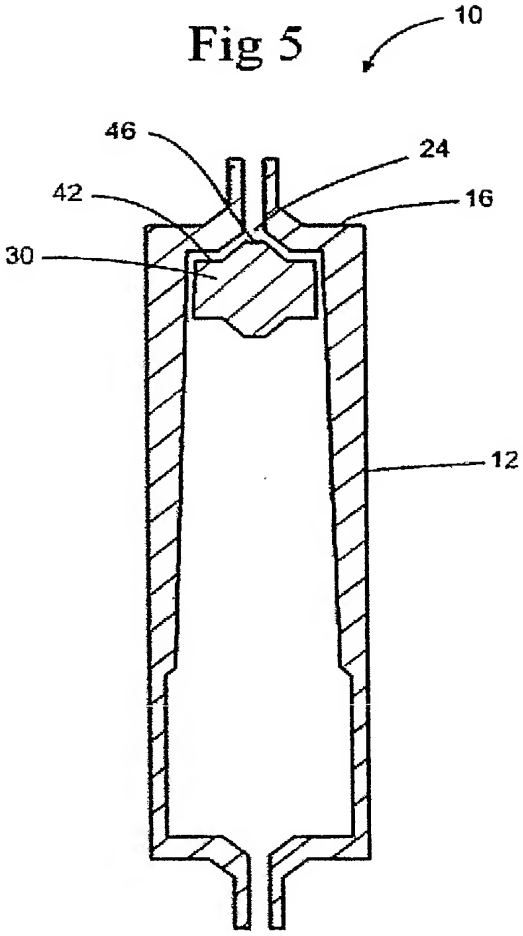


Fig 4

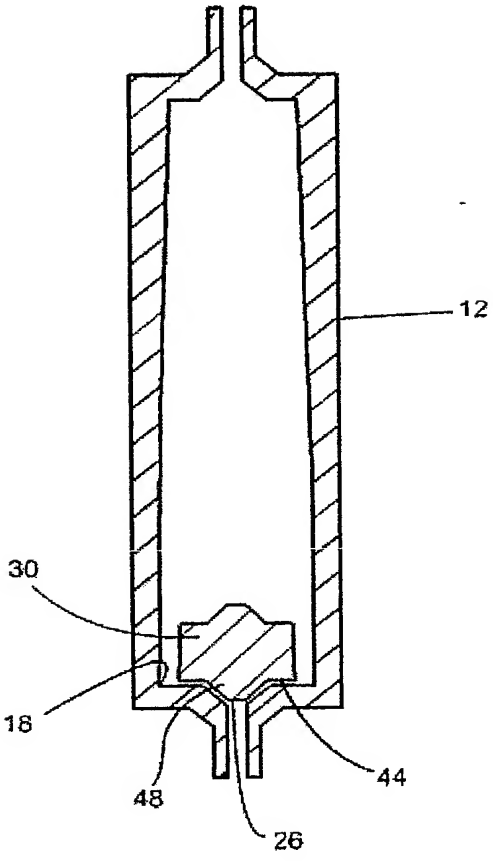


Fig 6

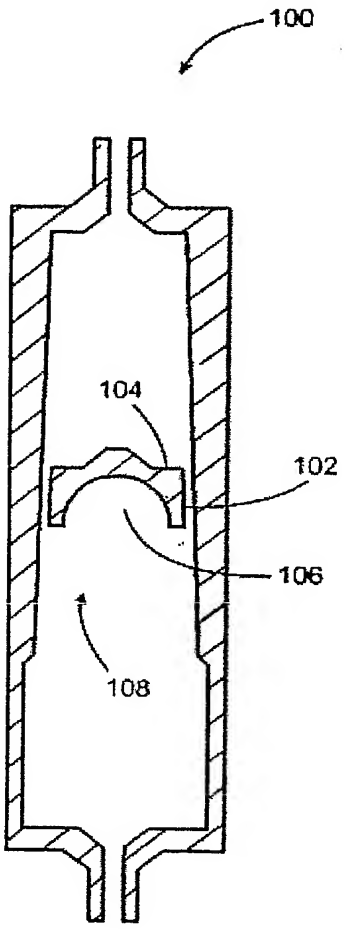


Fig 7

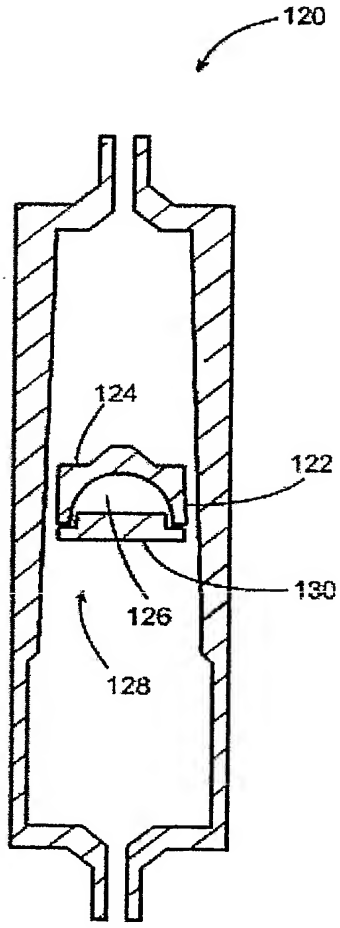


Fig 8

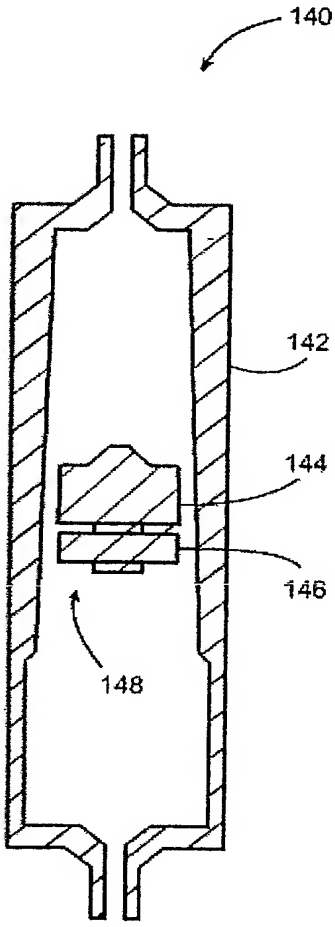


Fig 9

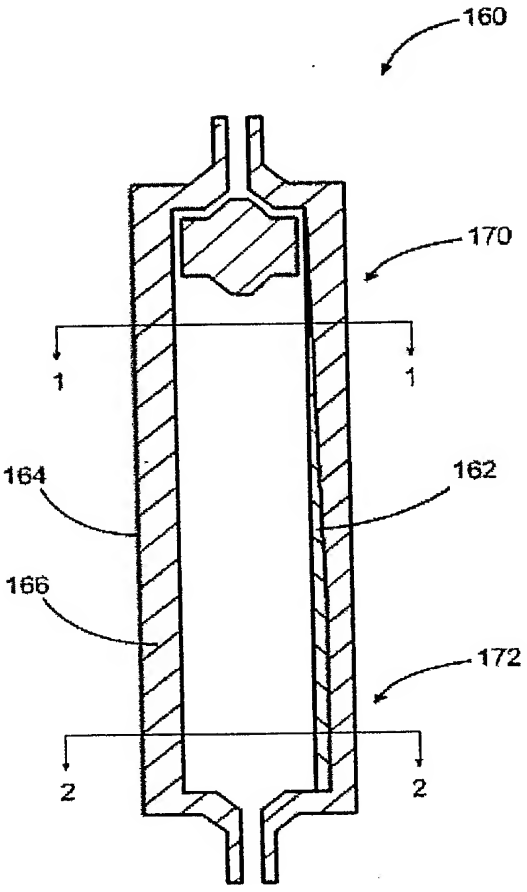
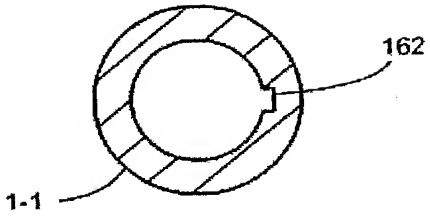


Fig 10



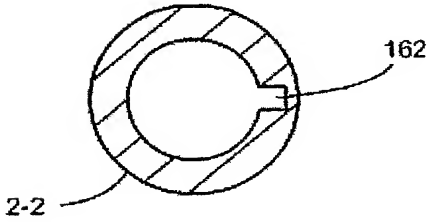


Fig 11

Fig 12

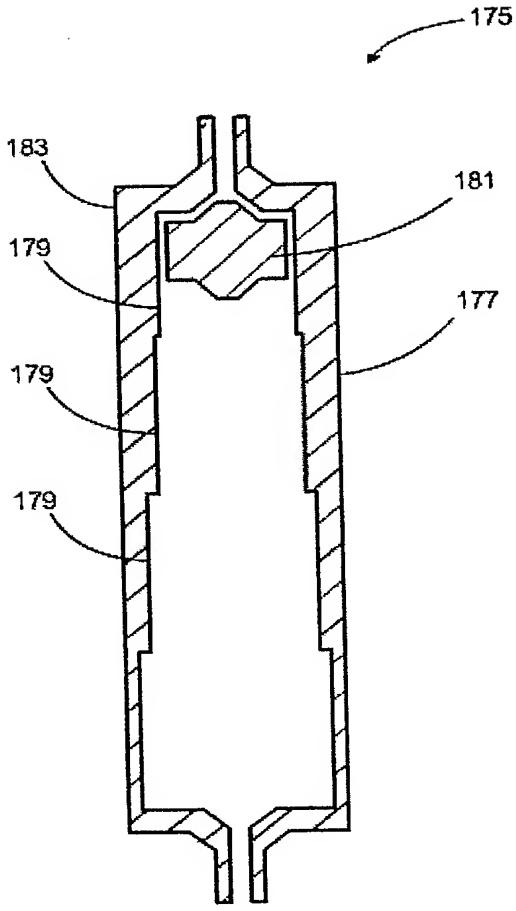


Fig 13

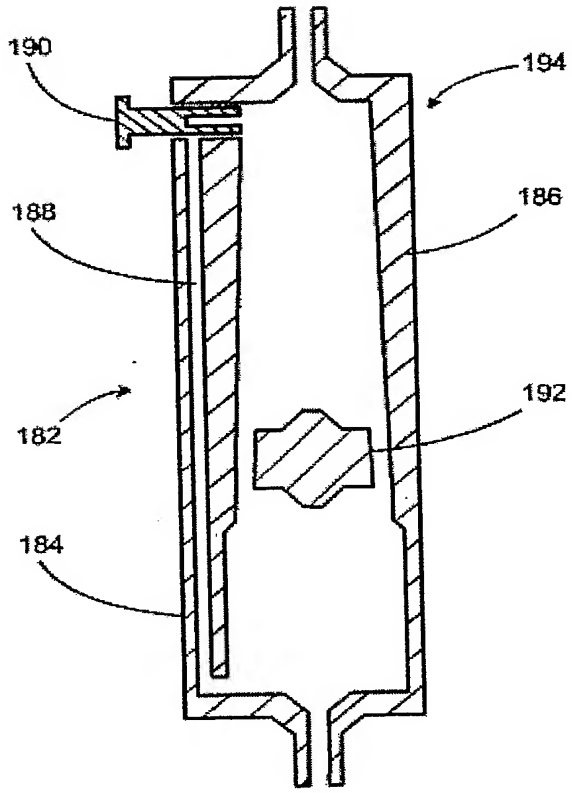


Fig 14

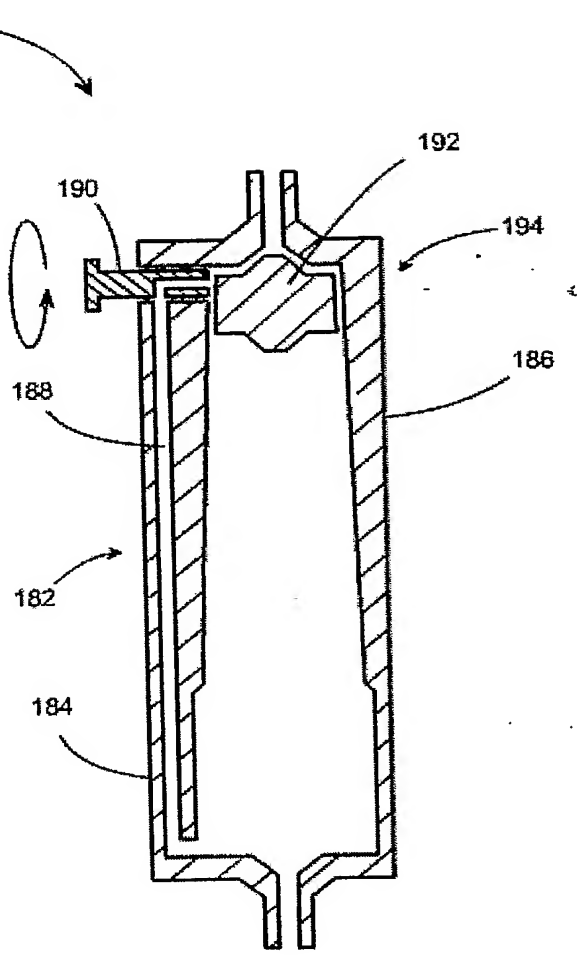
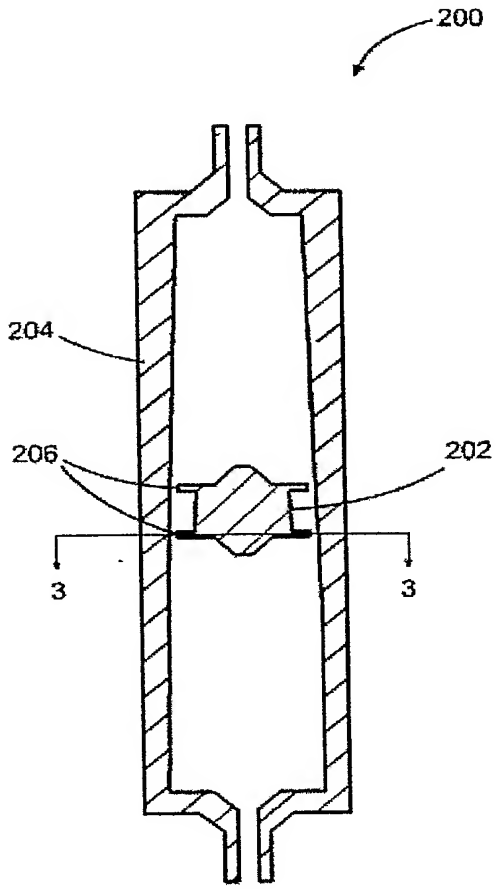
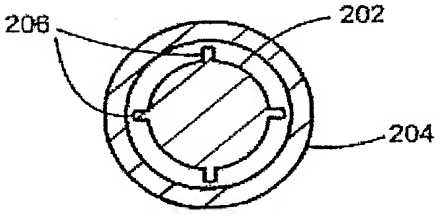


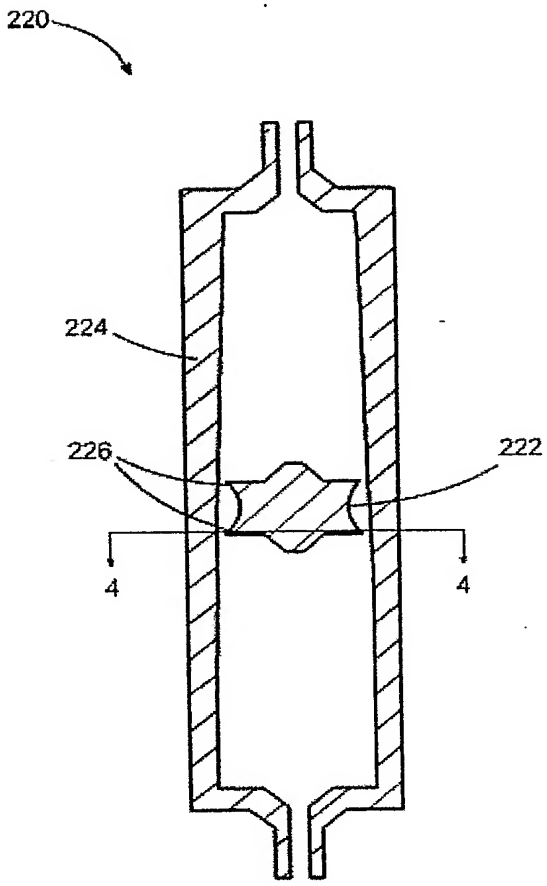
Fig 15

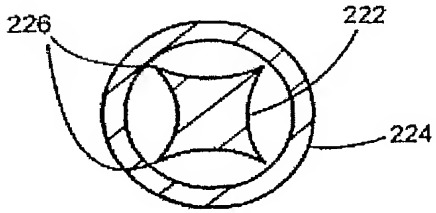




VIEW 3-3

Fig 16





VIEW 4-4

Fig 17

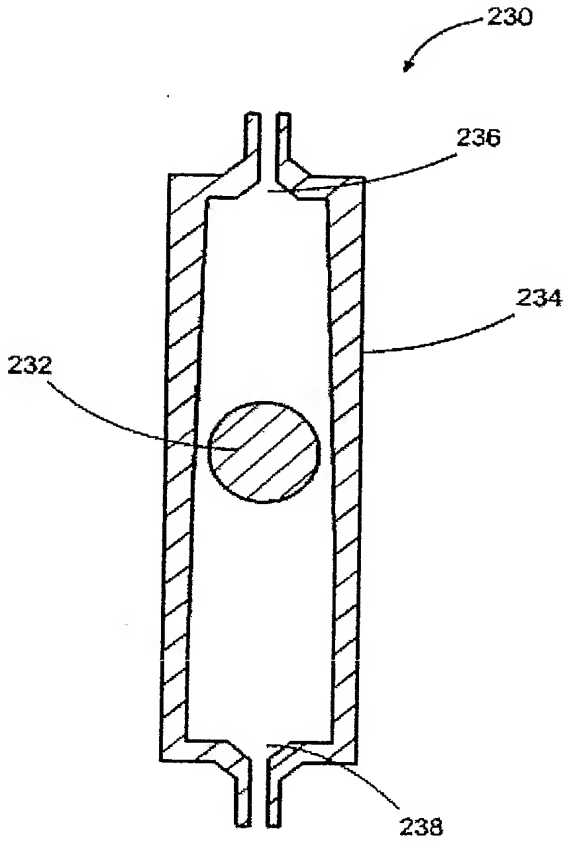


Fig 18